Automatic Detection of Brain Tumor through Magnetic Resonance Image

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Abstract- In this Review paper, it is intended to summarize and compare the methods of automatic detection of brain tumor through Magnetic Resonance Image (MRI) used in different stages of Computer Aided Detection System (CAD).In particular, Image Acquisition, preprocessing and enhancement, segmentation steps are studied and compared. In Preprocessing and Enhancement stage, medical image is converted into standard format with contrast manipulation, noise reduction by background removal, edge sharpening, filtering process and removal of film artificates. Segmentation determines as the process of dividing an image into disjoint homogenous regions of a medical image. The amount of resources required to describe large set of data is simplified and selected in for tissue segmentation.

Index Terms- Magnetic Resonance Image (MRI), Preprocessing and Enhancement, Segmentation, Feature Extraction, Feature Selection, Classification**,** Receiver Operating Characteristics curve (ROC).

I. INTRODUCTION

A. BRAIN TUMOR: Brain tumor is one of the major causes for the increase in Mortality among children and adults. A tumor is a mass of tissue that grows out of control of the normal forces that regulate growth. Most Research in developed countries show that the number of people who develop brain tumors and die from them has increased perhaps as much as 300 over past three decades. The overall annual incidence of primary brain tumors in the U.S is 11 to 12 per 100,000 people for primary malignant brain tumors, that rate is 6 to 7 per 1,00,000. In the UK, over 4,200 people are diagnosed with a brain tumor every year (2007 estimates In India, totally 80,271 people are affected by various types of tumor (2007 estimates). NBTF reported highest rate of primary malignant brain tumor occurred in Northern Europe, United States and Israel. Lowest rate arised in India and Philippines. The meninges are affected by a type of tumor called meningioma.

B. CAD SYSTEM We developed Computer-Aided Diagnosis (CAD) system for Automatic detection of brain tumor through MRI. The CAD system can provide the valuable outlook and accuracy of earlier brain tumor detection. It consists of two stages. First stage has preprocessing and enhancement. Second, feature extraction, feature selection, classification, and performance analysis are compared and studied. Preprocessing and enhancement techniques are used to improve the detection of the suspicious regions in MRI. The enhancement method consists of three processing steps: first, the MRI image is acquired. Second, removal of film artificates such as labels and marks on the MRI image and finally the high frequency components are removed. Segmentation describes separation of suspicious region from background MRI image.

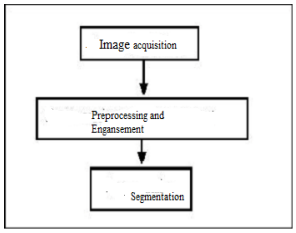

Fig.1 The outer section of CAD System.

II. DATABASE (IMAGE ACQUISITION)

To Access the real medical images like MRI, PET or CT scan and to take up a research is a very complex because of privacy issues and heavy technical hurdles. The purpose of this study is to compare automatic brain tumor detection methods through MR brain Images. The MRI data is obtained from the Brain Web Database at the McConnell Brain Imaging center of the Montreal Neurological Institute (MNI), McGill University . Brain imag can get from Web Interface (http://www.bic.mni.mcgill.ca/brainweb) [2]. All MR images were acquired on a 0.5T open interventional MRI system (Signa sp). MR Images were transformed on to a Linux network through LAN (KMCH Hospital,India). (All images had 1 mm slice thickness with 1×1 mm in plane resolution . The following figure shows the sample brain MRI.

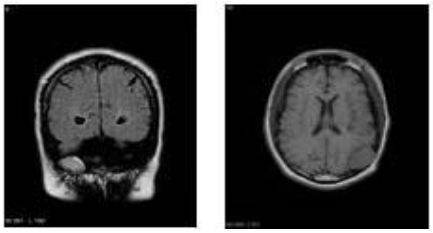

Fig. 2 The sample MRI epidermis brain tumor images.

Nowadays MRI systems are very important in medical image analysis. Detection of brain tumor requires high-resolution brain MRI. Most Medical Imaging Studies and detection are conducted using MRI, Positron Emission Tomography (PET) and Computed tomography (CT) Scan**.** MRI has a multidimensional nature of data provided from different sequential pulses [3]. An MRI scan can evaluate the structure of the heart and aorta, where it can detect aneurysms or tears. MRI scanners can produce 1500 images per second. Intraoperative MR imaging can acquire high contrast images of Soft tissue anatomy. MRI is the modality of choice for evaluating brain morphology because it provides superior soft-tissue contrast with flexible data acquisition protocols that highlight several different properties of the tissue.

III. PREPROCESSING AND ENHANCEMENT

Image processing and enhancement stage is the simplest categories of medical image processing. This stage is used for reducing image noise, highlighting edges, or displaying digital images. Some more techniques can employ medical image processing of coherent echo signals prior to image generation. The enhancement stage includes resolution enhancement; contrast enhancement. These are used to suppress noise and imaging of spectral parameters. After this stage the medical image is converted into standard image without noise, film artifacts and labels.

IV. PREPROCESSING

Preprocessing indicates that the same tissue type may have a different scale of signal intensities for different images. Preprocessing functions involve those operations that are normally required prior to the main data analysis and extraction of information, and are generally grouped **as** radiometric or geometric corrections. The Preprocessing aspects are surveyed and analyzed in this section. The Preprocessing Techniques such as Content Based model, Fiber tracking Method, Wavelets & Wavelet Packets, and Fourier transform technique [43; 73; 7; 54]. Olivier et al. designed a new Standard Imaging Protocol for brain tumor K radiotherapy. MRI has been acquired in the standard follow up after surgical resection.

Table 1: An overview of Preprocessing Methods

Methods	**Remarks**
Standard Imaging Protocol	MRIs have been acquired in the standard follow-up.after surgical resection.
Statistical Parametric Mapping, Pipe line Approach	It provides the solution of noise reduction,Inter-slice intensity variation correction,Intra-volume bias field correction,Linear & non linear alignment.
Content Based model,Shape based, Texture based technique,Histogram and Profilling Method	It showed detections of tumor with decrease in pixel count in binary images, increase in image intensity, High numbers of high intensity pixel.
Pixel Histograms, Morphological Process	It was more robust to noise and it can improve the integrity performance.
Boundary Detection Algorithm, Generalized Fuzzy operator(GFO),Contour Deformable Model, Region base technique	To obtain the fine result in the tumor consideration.
Boundary Model ,Non linear matching scheme	It represents the idealized MR intensity profile clearly.
Fiber tracking Method, Runge-Kutta method	The MR-DT1 datasets to be processed successfully.
Wavelets & Wavelet Packets, stein's unbiased Risk Estimate(SURE)[7]	It vanishes the noise coefficients by thresholding the detail components.
Fourier transform technique	Images were acquitted in the transaxial plane
Geometric prior,Bimodel	It is use to register the image
Unseeded Region Growing(URG) Algorithm	It is use to convert the MRI image into standard Formet.

Histogram based(HB),Subsecond imaging technique	Separate brain image, from head image removal of residual fragments such as sinus, cerebrospinal/fluid, dura, marrow.
Statistical Structure Analysis method	It gives 96.28% Accuracy.
PCA (Principal Component Analysis)	To minimize the artifacts present in the PET data set.
Neural Networks, Genetic Programming[30]	Large volume of data processed successfully.
Statistical Parametric Mapping Method	It is used to align the image properly and it uses left-to-right symmetry to confer robustness to areas of abnormality.
Independent Component Analysis(ICA)	Separate the components in MR images
Automatic Volume Registration method	It is used to remove artificats from MRI.
Head Model, Finite Difference Time-Domain (FDTD)	It is used to analyse different Tissue types.

V. ENHANCEMENT

Image enhancement methods inquire about how to improve the visual appearance of images from Magnetic Resonance Image (MRI),ComputedTomography(CT)scan,PositronEmissionTomography (PET) and the contrast enhancing brain volumes were linearly aligned. The enhancement activies are removal of film artifacts and labels, filtering the images. Conventional Enhancement techniques such as low pass filter, Median filter, Gabor Filter, Gaussian Filter, Prewitt edge-finding filter, Normalization Method [104; 23; 56; 93] are employable for this work.

Table 2: An overview of Enhancement Techniques

Methods	**Description**
Prewitt edge-finding filter	Extracts the image edges robustly and moves the vertices towards the boundaries of the desired structure.
Median filter	Low frequency image is generated and the mammogram images are enhanced using median filter; pectoral muscle region is removed and the border of the mammogram is detected for both left and right images from the binary image.
Genetic Algorithm(GA)	GA is applied to enhance the detected Border. The figure of merit is calculated to identify whether the detected border is exact or not.
Gradient-Based Method, Median Filter, Normalization Method	Shows the validity of detection of Memmographic lesions. Removes the high frequency components.
Triple Quantum Filtered Sodium MRI (TQF) Technique	blood brain barrier (BBB) breakdown develop.
Low pass Filter[95]	Takes care of local noisy fluctuations from MR images.
Triple Quantum Filtered (TQF) Sodium NMR [10]	Minimizes the effects of extra cellular fluids and Found Non-Contrast Enhancing tissue
Anisotropic Diffusio	The registered images are filtered clearly.

Edge Finding filter, Morphological operation.	Good performance compared to previous methods.
Gadolinium-Diethylenetriaminepentaacetic acid (Gd DTPA)Enhancement[6]	Provides additional independent information and improve the accuracy.
Novel image Approach[10]	Earlier detection of non-contrast enhancing tissue.
Prewitt edge-finding filter[4]	This filter enhances the tumor tissue greatly.
Morphological Filter	It is used to remove background.
Gabor Filter	HTD (Homogeneous texture descriptor) is extracted.
Gaussian Filter	Enhances image Boundaries.
Median Filter	The mammogram images are enhanced.
Gabor Filter Bank	It is used to remove the
Fuzzy C-means Clustering Method[100]	It is used to produce suspicious regions from MRI database and to improve the validity of the partitioning by splitting and merging clusters.
Hybrid level Set (HLS) Model[49]	It is used to segment edema and tumor.
Kohonen Self Organizing Map(SOM)[103]	It is used to segment the MR data in to regions that have similar characteristics.
Expectation Maximization(EM) Algorithm,	It is used to select the subsets of the expected
Multi Layer Markov Random Field(MRF)	regions efficiently.
Population-Based Tissue Maps, K Nearest Neighbor Model.	It is used to differentiate tissue types with high accuracy.
Level-Set Surface Model [1]	It is used to segment target regions from background tissue.
Support Vector machine	It is used to locate the boundary of an object quickly.
Genetic Algorithm	Segment objective region from MRI
Self organizing Map(SOM)	Segment the suspicious region.

VI. SUMMARY AND CONCLUSION

In this survey paper various automatic detection methods of brain tumor through MRI has been studied and compared for the period of more than two decades .This is used to focus on the future of developments of medical image processing in medicine and healthcare. We have described several methods in medical image processing and to discussed requirements and properties of techniques in brain tumor detection .This paper is used to give more information about brain tumor detection and segmentation. It is a milestone for analyzing all technologies relevant to brain tumor from MRI in Medical image processing. In this paper, various steps in detection of automatic detection:

i) The Preprocessing and Enhancement Technique
ii) Segmentation Algorithm and their performance have been studied and compared.

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